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INTERSTATE POLLUTION OF THE ANIMAS RIVER. COLORADO - NEW MEXICO SECOND TRANSCRIPT OF CONFERENCE

Public Health Service
Washington, D. C.

24 June 1959

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Second Session

TRANSCRIPT OF CONFERENCE

on

INTERSTATE POLLUTION

of the

ANIMAS RIVER

COLORADO - NEW MEXICO

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SECOND SESSION
CONFERENCE ON INTERSTATE POLLUTION
OF THE ANIMAS RIVER, COLORADO-NEW MEXICO

Mabry Hall
Santa Fe, N.M.
June 24, 1959

Chairman: Mr. Murray Stein
Chief of Enforcement Branch
Water Pollution Control Division
U. S. Public Health Service
Washington 25, D. C.

Conferees: Jerome H. Svore
Sanitary Engineer Director
Public Health Service - Region VII
Dallas, Texas

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New Mexico Department of Public Health
Santa Fe, New Mexico

Charles G. Caldwell, Director
Environmental Sanitation Services
New Mexico Department of Public Health
Santa Fe, New Mexico

William N. Gahr, Director
Division of Sanitation
Colorado Department of Public Health
Denver, Colorado

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OTHER APPEARANCES

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State of Colorado:

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Robert Reavis, City Engineer
Durango, Colorado

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(A list of others in attendance is attached as "Appendix A")

MR. STEIN: The conference is open. This conference in the matter of pollution of the interstate waters of the Animas River involving the States of Colorado and New Mexico, is being held under the enforcement provisions of the Federal Water Pollution Control Act. This is the second session of the conference. The first session was held here on April 29, 1958. A good deal of the background material is in the transcript of the first conference. However, to indicate for the record what we are doing, we might first describe very briefly the Animas River.

The Animas River in southwest Colorado above Silverton, flows southerly for approximately 100 miles to its junction with the San Juan River at Farmington, New Mexico. It crosses the Colorado-New Mexico State line near Riverside, New Mexico, a point approximately 30 miles from its mouth.

The Animas River basin has an overall length of approximately 100 miles, 70 of which are in Colorado and 30 miles in New Mexico.

The Federal Water Pollution Control Act provides that pollution of interstate waters which endangers the health or welfare of persons in a state other than that in which the pollution originates, is subject to abatement. This conference will determine whether, in fact, such pollution does exist; and if it does, it will provide a record indicating progress which has already been accomplished, if any has been made, and also pointing up what still needs to be done in correcting an interstate pollution problem if the problem exists.

Under the Federal law the Surgeon General is required at the conclusion of the conference to prepare a summary of the conference which will be sent to all conferees. The summary, according to law, must include the following:

1. Occurrence of pollution of interstate waters subject to abatement under the Federal act;

2. Adequacy of measures taken toward abatement of pollution; and

3. Nature of delays, if any, being encountered in the abatement of pollution.

It is suggested that conference discussions be directed toward these points so we may prepare a useful summary. In addition, the law requires the Surgeon General, at the conclusion of the conference, to determine whether effective progress toward abatement of pollution, if such pollution exists, is being made.

To aid the Surgeon General in making this determination, it is strongly suggested, if appropriate, that the conferees agree upon a schedule of remedial action. This conference, under the law, is a conference between the Public Health Service and the states concerned. The states are Colorado and New Mexico, and the official State Water Pollution Control agencies for these states are the Colorado State Department of Public Health and the New Mexico State Department of Public Health. Representing New Mexico are Doctor Stanley J. Leland, and Mr. Charles G. Caldwell; representing Colorado is Mr. William Gahr; representing the Public Health Service is Mr. Jerome Svore, Regional Engineer with headquarters in Dallas, Texas; and my name is Murray Stein. I am from Headquarters of Public Health Service.

An agenda has been provided for the conference. This agenda is a verbal one, and it will follow the same procedure we followed in the last conference. Conferees will be permitted to make a statement, call on other persons to make statements, and the conferees will be permitted to ask questions.

We are having a stenographic report made of these proceedings and copies of the summary and transcript will be made available to the conferees and the official state agencies. Other people desiring to receive copies of the transcript and summary we prepare at the end, should get in touch with the official State Water Pollution Control Agency. The distribution will be made through the States.

Both the States and the Federal government have responsibilities in dealing with interstate Water Pollution Control problems. The Federal act declares that the states have primary rights and responsibilities for taking action to abate and control interstate problems. It has been the policy of the Public Health Service to recognize this traditional role of the states. The function of the Service is to encourage the states in this activity. However, the Public Health Service is charged by law with specific responsibilities in connection with interstate pollution problems. It is in discharge of this responsibility that we are here today in this enforcement procedure of which the conference is the first step. We are always hopeful that no other step will have to be required other than the conference.

Before we start, we would like to briefly go over the pertinent points of the summary of the first session of the conference, to indicate what this conference will do and what we are charged with doing. At the first conference the conferees unanimously made the following conclusions and recommendations:

1. From the material presented at the first session, it is too early to attempt to delineate with any specificity;

   a) occurrence of pollution of interstate waters subject to abatement under the Federal Act;

   b) adequacy of measures taken toward abatement of pollution; and

   c) nature of delays, if any, being encountered in the abatement of pollution.

2. Therefore, the conference held on April 29, 1958, was considered to be the first session of the conference, with future sessions to be convened at the call of the chairman.

3. The material presented at the first conference indicated that further investigation and study was needed to define the type of interstate pollution problem which may exist in the interstate waters of the Animas River.

4. That this pollution problem may be divided into two areas:

   a) Pollution of industrial sources having radiological significance; and

5. Pollution from sources not having radiological significance may be of various kinds:

   a) wastes from refuse or garbage which are alleged to be introduced into the Animas River near Silverton, Colorado;

   b) liquid municipal wastes from Silverton and Durango, Colorado; and

   c) wastes from mining operations and abandoned mines in the Silverton, Colorado area.

6. The Colorado Department of Public Health will prepare a report on the non-radioactive pollution situation by July 1, 1959.

7. An investigation of the radioactive aspects of the pollution problem of the Animas River which may be due to uranium milling operations in Colorado will be undertaken by the Public Health Service. The State Water Pollution Control Agencies of Colorado and New Mexico, and the Atomic Energy Commission, will be invited to participate in this investigation.

At the conclusions of this investigation the conference will be reconvened on the call of the chairman, so that the conferees can come to definite conclusions and recommendations. The Public Health Service investigation and study has been substantially completed, and as a result this session of the conference was called. The Public Health Service has complied with the legal requirements for calling the first and second sessions of the conference.

I think with that we can call on Mr. Svore for the presentation of the Public Health Service study and investigation.

MR. SVORE: Thank you, Mr. Stein. It was not my privilege to attend the first session of the conference that was held in April, 1958. However, I have had an opportunity to reveiw the transcript. I do not believe that it would add much at this time for me to go into any further detail on what was covered during the last conference. I believe that our job here today is to get on with the matter of determining what the situation is at the present time and of course what the plans are for correction. I sincerely hope that the solutions that are recommended will be the type of solutions that are feasible and that can be brought to a conclusion within the very near future.

To start the Public Health Service's presentation and a review of the data that have been collected during the survey for the last year, I would like to introduce Doctor Tsivoglou, who will make his presentation.

DOCTOR TSIVOGLOU: I would like to say to start with, this report that was put out on June 1, which is a report of the Survey of Interstate Pollution of the Animas River, it presents a joint survey in which we had the cooperation of a number of agencies; the State of Colorado, Department of Public Health, New Mexico Department of Public Health, State of Colorado Department of Game and Fish, San Juan Basin Health Unit in Durango, San Juan County Health Department in Farmington, New Mexico, U. S. Atomic Energy Commission, U. S. Geological Survey, and the Vanadium Corporation of America.

I think it was agreed at the last meeting that we were not sure of the facts and they had to be determined. All of these agencies and organizations participated and assisted in determining the facts and therefore this represents a joint report.

The objectives of the study were to evaluate the internal radiation exposure to radium and strontium-90 in the Durango-Farmington population area, and the portion of this total exposure resulting from radium and other waste discharges from the uranium mill at Durango; and on the basis of the above evaluation, to assess the interstate pollution aspects of the refinery discharge.

The survey was begun in July, 1958, and was planned to include the period of a year. A good bit of the information is now available and it was felt sufficient information in order to proceed with the meeting.

I think it is appropriate to discuss at this time the water uses that we have been concerned with on the Animas River. It serves as a source of domestic water supply for two communities in New Mexico, Aztec and Farmington, with a combined population of about 28,000. It serves as a source of water supply for a number of individuals, I think about 1800 in New Mexico who use the water in its raw state as it comes from the river. It serves also for irrigation of some 24,000 to 26,000 acres of crop lands in New Mexico and below Durango, primarily in New Mexico. It serves recreational purposes, fishing and swimming (apparently) in the vicinity of Durango and downstream from the refinery. It serves also to some extent for stock watering. This point was not investigated as such. The uses on which information was provided are primarily the domestic water supply use and irrigation water use, and what effects the radium concentrations in the water may have in terms of crops growing in the area.

There were some prior data, but they were very meager. As Mr. Stein pointed out, there were a few samples taken in 1955. They could not be considered representative of any long period of time and I don't think we need to discuss it again as they were in the transcript of the prior meeting.

In terms of radiation exposure and existing standards, this statement is included in the report of June, 1959, and is the basis on which we have gone ahead:

Radioactive materials that are ingested or inhaled result in internal radiation exposure, as contrasted to the external exposure resulting from a source of penetrating radiation located outside the body. Upon ingestion, certain radioactive elements tend to accumulate in specific body organs. For example, radium and strontium-90 accumulate in the bones, while iodine goes to the thyroid gland. Such radioactive materials irradiate the surrounding tissue until they have decayed or have been biologically eliminated. As regards radioactive waste from the refinery at Durango, we are concerned with internal exposure of the local population, and the remainder of the statement only concerns internal exposure.

In determining criteria for the safe disposal of radioactive wastes it is important to consider all means by which the local population is exposed to radiation. The effects of radiation exposure are cumulative and the total exposure of the population is much more significant than the fraction of it associated with one particular source, such as drinking water. An individual or community may drink slightly contaminated water or milk; they may eat slightly contaminated food or they may breathe slightly contaminated air. A portion of

these individuals may during their working hours inhale or ingest somewhat higher amounts of radioactive materials as a result of their occupation in the nuclear industry. It is the total exposure that has the real significance, and it is important to examine each source such as a domestic water supply, in the light of the total radioactive intake from all sources. While any individual exposure, therefore, such as that from a domestic water supply may be lower than the maximum allowable or that generally regarded as safe, the total exposure from all sources may exceed that regarded as safe.

At the time this report was written the available information on maximum permissible concentrations was Handbook 52, of the National Bureau of Standards, and the Atomic Energy Commission Regulations, Part 20, published in the Federal Register. The report is based on the figures given in those documents. In essence, Handbook 52 indicates that the maximum allowable or permissible concentrations of radium in a domestic water supply should be no more than 4 micromicrograms per liter. This is based on the idea of intake of 2.2 liters per day by individuals; in other words, a total daily intake of 8.8 micromicrograms of radium.

For strontium-90, the maximum permissible concentration in Handbook 52 is 80 micromicrocuries per liter. I should say these are the MPC's of Handbook 52, with a factor of 10 applied, as advised in the addendum to Handbook 59. The MPC for strontium-90, then, is 80 micromicrocuries per liter. Again, using the 2.2 liters per day, this results in a total daily intake of 176 micromicrocuries of strontium-90.

Now, it is a well established principle that the bones don't much care what the source of radiation is, so that if we had the total allowable amount of radium present, and added to that some strontium-90, we would exceed the allowable radiation exposure to the bones. The converse is also true; if you had in a water supply and food, a cumulative intake of 176 micromicrocuries per day of strontium-90, then any radium intake would again result in exceeding the dose regarded as safe. So that the presence of one affects the allowable amount of the other. About the only way to approach this is to think in terms of total intake in fractions of the allowable amounts, in the sense that if I had 50% of the allowable amount of strontium-90 present, then I should strive to have no more than 50% of the allowable amount of radium present.

The allowable amount of discharge or effluent from any industry depends fairly much on how much dilution is available in the receiving stream, and so considerable effort was put forth to determine or evaluate the hydrological aspects of the Animas River as it flows past Durango. There is in the U. S. Geological Survey water supply papers an extensive record of flows of the Animas River at Durango, Colorado, at Cedar Hill near the State Line, and at Farmington, New Mexico. This record goes back in continuous fashion for 22 years which provides a good basis for statistical studies. What was done, in the low frequency studies, was to use Durango as a control location because that is where the river receives the waste in which we are interested; therefore the amount of water at Durango is the controlling factor as far as dilution is concerned. We should say also that the river flow at Farmington, New Mexico, for instance, in certain months of the year may be considerably less than that found at Durango, Colorado, for the reason that a great deal of the water is diverted below Durango for irrigation purposes and is not returned to the river until it has passed Aztec and Farmington, New Mexico.

To give you an idea of the frequencies of flows at Durango: the average annual flow for the Animas River at Durango, over the 22 years of record, was 701 cubic feet per second. The minimum monthly average flow at Durango, over that entire period, was 179 cubic feet per second, that is, on the average for the 22 years. The lowest monthly average flow that occurred in the 22-year record was 141 cubic feet per second: the highest was 261 cubic feet per second.

The expectancy of flows is as follows: it can be expected that a flow at Durango of 175 cfs, or less, will occur once every two years; that is, the minimum monthly average flow. Once in every five years the minimum monthly average will drop as low as 159 cfs; once in every 20 years it will drop as low as 138 cfs. Minimum daily average flows may be expected as low as 110 cfs.

During the survey period, we had flows that were somewhat higher than may be expected in an ordinary summer. The flow varies from 500 cfs at Durango down to 290 - 295 cfs. That was the minimum flow, and those were weekly averages.

We also collected precipitation samples both at Durango and Farmington, and obtained a record of precipitation for the survey period; so we know how much there was, and we had samples for analysis. Now, if you will look at the map (indicating map on wall), there were a basic four or five sampling stations established. One, above the uranium refinery and above pollution from Durango, Colorado; in other words, a background or control location. Another basic station was about two miles below the uranium refinery at Durango; one, just a few hundred yards above the confluence of the Animas River and the Florida, which brings in some dilution water; and one was established at the State line. We had also sampling stations at the water plants at Aztec, New Mexico and Farmington, New Mexico.

With those stations in mind, the next thing to do would be to call on Mr. Sponagle to discuss the survey of the process used at the refinery at Durango. Mr. Sponagle, with the cooperation of the industry, Mr. Brinker, Mr. Maxwell, and Mr. Roland Vesper, conducted a survey in the plant at Durango in order that we might all understand the process that was carried on, and the sources, in detail, of wastes that may arise. If it is appropriate now I would like to call on Mr. Sponagle.

MR. STEIN: Mr. Sponagle.

MR. SPONAGLE: I have some charts over here, which are an explanation of the principal factors involved in the processing of this ore. Can everyone see this? (Indicating diagrams). (REFER to FIGURE 13, "FLOW DIAGRAM", opposite page 36 in Report).

The ore received at the mill is roasted: the calcines from the roasters are sorted into circuit tank liquor, which is a liquid process, and run into leach tanks where they are leached with sodium carbonate solution for the removal principally of vanadium from the sands. Alkaline liquor coming from the leach tanks is processed for the removal of vanadium and also uranium which is dissolved. The sands proceed next to an acid leach process very similar to the alkaline leach except that sulphuric acid is used to leach the uranium from the sands which is picked up, as compared to the acid liquor coming from these leach tanks. This liquor is run from the storage tank as the uranium is extracted from it by a solvent process; the function of which is to transpose the uranium successfully

from this particular liquor into a solvent, then into a sodium carbonate solution which is returned to the circuit tank and becomes a part of the circuit tank liquor. It is then processed in the alkaline liquor circuit. Following the acid leach, the sands are slurried with water, pumped into a tank and the liquor overflows from the tailings pond into the river.

I have on the next chart, the processing of the alkaline liquor for removal of the vanadium and uranium. The alkaline liquor from the storage tanks is run into the uranium precipitation tanks where the uranium is precipitated. The contents of the tank are then discharged to two filters where the uranium slurry is filtered out as yellow cake, a process for the removal of impurities, dried, and then shipped to the AEC.

The liquor from the filter press empties into the vanadium precipitation tanks where vanadium is precipitated. Following this, the tank contents are dumped into the filter tray, the liquid evaporated by application of a vacuum, and drained to the river. The red cake remaining on the tray is dried, and most of it is fused in the furnace to form V_2O_5.

To give you some idea of the geographic location of these things I have been talking about (referring to chart); Durango is located on this side of the river - here is the river. This is the general mill area in which the processing takes place. The red lines represent waste discharge going to the river.

Here, what we call the main plant effluent, contains the waste discharge from the vanadium filter tray, the waste constituents from the solvent extraction process, and an iron aluminum sludge which is present in a small amount, resulting from the purification of the yellow cake -- a development from that process. An overflow from what we call a primary tailings pond occurs at this stage of the process, between alkaline and acid leach. This overflow is intermittent and occurs about 50% of the time.

There are two discharges of final tailings. We found one to be a constant discharge to Lightner Creek; the other empties into the Animas River, but it was intermittent. It also flowed about half the time we were there.

To give you some idea of the flows involved; the main effluent averaged 270 gallons per minute; the flow from Lightner Creek was 71 gpm; this one averaged 55 gpm. (Indicating Chart).

The survey was conducted just a little less than a year ago. We arrived at the mill on July 28, 1958, and we stayed at the mill through August 5. We had three men on our survey crew and the fourth man was supplied on a part-time basis by the San Juan County Health Unit. Samples were collected hourly at each of these stations, that I have shown you on the chart -- each of the discharges to the river. We collected the samples in three cycles: Cycle A was a 16-hour sample; Cycle B and C were each 56-hours of continual sampling at these points. Other points were sampled throughout the mill, but I don't think that we will go into that at this time.

I believe that will finish my presentation. If there are any questions I will be glad to answer them.

MR. STEIN: We will get the questions afterwards, let's finish the presentations first.

DOCTOR TSIVOGLOU: I think it is pertinent next to take up the results of the sampling in the river and of the local environment, with data that will represent averages for an 8-week survey period from July through about mid-September, 1958. There are subsequent samples that have been collected and the analyses are not completed at this time. However, we believe that the two-month summer survey results give adequate information for our purposes today.

I think that in order to be brief I won't talk about gross alpha-beta radioactivity, although these were measured. I will confine these remarks to radium, with just a few remarks about strontium-90 and uranium.

At Station 1, which was the location about one-half mile above the refinery on the Animas River and therefore unaffected by any wastes from the Durango population, the dissolved radium concentration averaged about 0.6 micromicrograms per liter.

At Station 2, which was located two miles below the mill where we had automatic sampling equipment, the dissolved radium averaged 12.6 micromicrograms per liter; an increase then from 0.6 up to 12.6 on an average.

To give you an idea of range at Station 2; we had eight weekly composite samples, in which the radium concentration ranged from 9 to 19 micromicrograms per liter. Above the confluence of the Florida River, the Animas contained about 7.2 micromicrograms per liter of radium; at the State line it averaged 7.6; at Farmington, New Mexico it averaged about 2.9. These figures can be compared with the allowable amount as given by Handbook 52 and Handbook 59.

In terms of milligrams per day, which is a quantity passing a given point in the river rather than concentration and has perhaps more meaning, the dissolved radium content passing Station 1 was about 0.5 milligrams per day; passing Station 2, or just below the mill a few miles, it was 11.5 milligrams per day; at the State line it was about 8 milligrams per day; and at Farmington about 1.6.

A part of the reason for the large drop between the State line and Farmington, New Mexico was the use of irrigation waters. In other words, concentrations in the river diminished some, probably because of dilution with return irrigation flow and the Florida River. The quanitity of river flow, cubic feet per second, was also diminished down at Farmington because a lot of the irrigation diversion had not been returned. And so, these two effects combined to give a considerably reduced quantity of dissolved radium passing that location.

A few selected samples were analyzed for uranium at Stations 2 and 5; two miles below the mill and at the State line. The dissolved uranium averaged about 130 micrograms per liter below the mill, and about the same at the State line. In other words, there was very little change. This can be contrasted with natural amounts in the neighborhood of 2 or 3 micrograms per liter.

The chemical content of the river water is not too important here. There were trace amounts of arsenic, vanadium, possibly selenium and zinc that appeared to be added at the mill; but with the dilution there the increase was not large.

Coliform bacteria, indicative of fecal pollution, human or animal, were measured on three occasions in a series downstream; at the station above Durango, at the station below Durango, at the Colorado-New Mexico State line, above Farmington, and below. The most probable number of coliforms per hundred milliliters of water above Durango averaged about 20, below Durango in the neighborhood of 300 or 400; at the State line in the neighborhood of 100; and above Farmington, New Mexico they can't be averaged -- one result was 56, one 220, and one was 1600. Below Farmington they averaged about 200 coliforms per 100 ml. They indicated definite additions as sources of pollution, but not great additions as far as bacteriological pollution is concerned.

Biochemical oxygen demand is indicative of organic matter present in the water; feces, garbage, and organic matter of various kinds. In essence, biochemical oxygen demand is a measure of how much oxygen will be consumed due to the bacterial attack on the organic material present.

The contrast in the measured dissolved oxygen in the river water itself is to see how far the dissolved oxygen has dropped because of the addition of organic material. In the first place, there was no indicated drop in dissolved oxygen below Durango, in fact it increased very definitely by about 2 parts per million. The river above Durango contained an adequate amount of dissolved oxygen for the preservation of fish and aquatic life; the river below Durango contained about 2 ppm more than above Durango even where some of this organic material was added. This would be due to the presence of algae or small green plants growing in the water, which during the daylight hours perform photosynthesis and produce oxygen. At the Colorado-New Mexico line the dissolved oxygen was still higher than it had been above Durango, above Farmington it was still up; and below Farmington there was some decrease but not a large amount.

The biochemical oxygen demand showed an increase of about 2 ppm at Durango. In other words, there were 2 ppm more below Durango than there were above. This diminished due to bacterial attack, and at the Colorado-New Mexico line it was still a little bit higher than it had been above Durango, but not markedly so -- perhaps in the neighborhood of 1 ppm.

I would say that the river normally contains 7 to 8 ppm of dissolved oxygen; while you might require the addition of 8 to 10 ppm biochemical oxygen demand in order to reduce the DO levels in the river to undesirable concentrations.

As far as domestic sewage is concerned, while it is present, no major pollution problem was indicated. Samples were taken on a composite basis at the water plants at Aztec and Farmington, New Mexico.

The radium concentrations at Station 5, at the Colorado-New Mexico line, were taken as indicative of the type of water that the raw water users in New Mexico might be exposed to. The radium content of the river at Station 5 averaged about 7.6 micromicrograms per liter; at Aztec water plant it averaged about 3.4 in the raw water, and 3.6 in the tap water. In other words, oddly enough, the tap water seemed to contain a little bit more dissolved radium than the raw water supply, and we will go into that in a minute.

At Farmington, dissolved radium in the raw water averaged about 2.8 micromicrograms per liter, and the tap water 2.6, or slightly better.

A few samples taken at Shiprock, which is on the San Juan River some twenty-five miles below its confluence with the Animas at Farmington, indicated background amounts of dissolved radium, or about 0.4 micromicrograms per liter.

It can be concluded from this data that the conventional water treatment plants at Aztec and Farmington do not affect the radium concentrations in the water in substantial degree. In other words, no dependable or significant reduction in the dissolved radium content was effected by the water treatment process.

At Aztec a few samples of filter sands were analyzed. The average radium content for samples of the Aztec water plant filter sand was about 27 micromicrograms per liter. Now this is contrasted with filter sands at Farmington which contained about 4.7 micromicrograms per liter. At Shiprock they averaged 2.6. In other words, it appears that some of the suspended material in the river water accumulated on the filter sand and resided there. We think this explains the observed slight increase in the dissolved radium concentrations in the tap water at Aztec. In other words, over eight weeks of composite sampling we observed a small average increase of dissolved radium in the tap water over the raw water at Aztec. At the same time, the filter sands at Aztec contain 5 to 6 times as much dissolved radium as those at Farmington or Shiprock.

We collected river mud samples every two weeks. In other words, we collected 4 samples during the summer at the various sampling stations. Some of these have not been analyzed for radium, but better than half of them have. They indicate a radium content of 1.7 micromicrograms per gram of mud above Durango. One sample analyzed at Station 2, below the mill, indicates 115 micromicrograms of radium per gram of mud; at Station 4, which was above the confluence with the Florida River, an average of 48 micromicrograms of radium per gram of mud; at the State Line an average of 21, and at Farmington an average of about 3.7 to 4 is shown. In other words, by the time it reached Farmington the radium content of the mud was about three times that above Durango.

River algae and aquatic insects, and some minnow samples, have been analyzed. The minnow samples have not been analyzed for radium, but they have been analyzed for gross-alpha-beta activities. They consist of speckled dace, sculpin, fathead minnows and suckers, mainly. To give you an idea; the gross alpha activity in minnow samples above the mill was about 3.3 micromicrocuries per gram of ash material, and below the mill about 290. The data has to be taken with a grain of salt because the minnow samples were not dissected or analyzed in part. They were homogenized in a waring blendor completely, and samples of that material were taken and analyzed for gross activity. Some of these minnows are bottom feeders, and as a result probably have some river mud in their gut; and this material was analyzed with the sample.

Algae indicated gross alpha activity on the average of about 23 micromicrocuries per gram above the mill; about 3910 below the mill; about 1520 at Station 4, above the confluence with the Florida; about 910 at the State line; and about 120 at Farmington -- as contrasted with 23 above the refinery. Bottom insect samples were analyzed, and showed about the same proportion.

Radium content in micromicrocuries per gram of ash material, again; above the refinery, algae showed about 4.8 micromicrocuries per gram of radium; at Station 2, two miles below the mill, showed about 390; at State line about 90; and at Farmington about 26.

Milk samples were analyzed. They were collected routinely on a monthly basis from milk routes where milk was collected in the area and delivered to Farmington where a new pasteurization plant was to be constructed. The strontium-90 content averaged about 5.4 micromicrocuries per liter of milk. Another point of interest, Cesium 137 averaged about 35 micromicrocuries per liter.

Precipitation samples indicated somewhat more radioactivity in the New Mexico Aztec-Farmington area than the Durango area. This is fairly consistent through the data; there are 8 or 9 samples from Durango rainfall and about 12 from Farmington, with a definite indication of more activity in the Farmington area. We think this is probably due to the topography and meteorology of the area, in the sense that the prevailing winds are apparently from the south toward the north. The lower half, or New Mexico portion, of the Animas River Basin is fairly flat open country and as you proceed north from the State line the country begins to close in and the valley narrows as you approach the mountains.

Vegetable crop samples were analyzed for radium, and some for strontium-90 and other materials. Some 30, or probably more like 40, samples are represented. These samples were collected from farms throughout the area; some from farms located above the uranium refinery and north of Durango; others from New Mexico farms downstream that use the Animas River for irrigation water. The results are presented in detail in the report.

In general, the radium content and strontium-90 content of the vegetables taken from New Mexico farms were somewhat higher than those taken from farms upstream from the mill. Strontium-90, of course, has to be attributed to fallout. There should be no radium that we know of, or at least in substantial amounts, in fallout. An indicated increase of radium by a factor of about 2 was found in the New Mexico vegetable samples, as contrasted with those from above Durango, and this has to be attributed to waste discharges and the radium content of the irrigation water that was used.

This summarizes the results of the environmental survey. Before we talk very briefly about exposures to humans in the area, I think it is now appropriate to call Mr. Joe Anderson, to discuss the biological field work.

MR. STEIN: Before we call Mr. Anderson, I understand that coffee is ready. Let's take a ten-minute break for coffee.

RECESS

MR. STEIN: May we reconvene? The conference is reconvened, and we will continue with the Public Health Service's presentation. Mr. Anderson.

MR. ANDERSON: I will describe the bio-assay studies. These studies were composed of two parts. One part was a stream study to determine the effects of waste on the organisms which inhabit the bottom of the stream. The second part was a bioassay study to determine the effects of mill wastes on fish. In order to conduct the stream study, several stations were selected along the river. These stations were above the mill, Lightner Creek above the mill waste discharge, Florida River and several points along the Animas River. The purpose of this study was to collect bottom organisms which normally live in the bottom of the stream and to determine the variations in their numbers and the kinds of organisms. These organisms of course are very important to the fish since they must depend upon them for their source of food.

Briefly, the results of these studies were that above the mill, on Lightner Creek and on the Florida River, we got large numbers of organisms. These were also sensitive organisms to pollution or low dissolved oxygen, and consisted of caddis flies, may flies, and stone flies. The numbers ranged from over 10 to as much as 4,50 organisms per square yard. I might add that in collecting these organisms a screen was placed downstream, the rocks were scraped and uncovered, and the current carried the organisms onto the screen. These were picked up from the river and of course preserved, counted, weighed, and identified later on.

I have mentioned that there were as many as 450 organisms per square yard in the Animas River above the mill. Below the mill a study was done across the river to determine the effects of the mill wastes. On the west side of the river no organisms could be found. This is the place where the mill waste was most concentrated. In the middle of the river just a few organisms were found, and on the east side of the river over 100 organisms were found. Then, about two miles below the river, where the waste had had a chance to mix thoroughly with the receiving water, less than 2 organisms per square yard could be found, and these were fly larvae which are very resistant to pollution.

At the State line, about 14 organisms were found per square yard. Then, as we proceeded down some 36 to 40 miles below the mill, the numbers of organisms picked up to about 62 per square yard 36 miles below the mill, and we got a normal population 48 miles below the mill, there being 423 organisms per square yard.

I think this summarizes pretty well the stream study, to show that the population of organisms which is very large above the mill declines immediately below the mill. Then, as the water flows downstream there is a point below the State line where we return to near normal concentrations of organisms.

The second part of the study, consisting of bioassay studies, was to determine the effects of the mill wastes on fish. A laboratory was set up at the State Fish Hatchery. Test containers were arranged, rainbow trout were obtained from the fish hatchery and the various mill effluent components, and the main effluents themselves, were sampled and used for the test.

In testing these effluents, we would place a small number of fish into the test solution and then observe the fish for various periods of time. These fish would be observed for 72-hr, 96-hr, and in some cases longer periods of time, to determine the number of fish which would die.

Following the collection of this data in which the time of death was determined, the Median Tolerance Limit was established. The Median Tolerance Limit is simply the concentration of wastes where 50% of the fish will die. This figure, then, is used for determining proper dilution volumes that must be had in order that fish survive. I would like to emphasize again that the Median Tolerance Limit is a point at which 50% of fish die. That is, we have got to have an application factor, or more dilution, or less waste, in order to keep fish alive.

The main effluent killed one-half the test fish in a 96-hour period, at a concentration of .31 to 7.6%. There was a range there, but generally about .31 to 1½% killed the fish. The Vanadium filter wash killed fish in the range of .82 to 4.2%, an average figure of about 2% can be used. The organic raffinate was the most toxic. One sample killed fish in a concentration of .09%, and the highest concentration required to kill half the fish was .21%. The primary tails was the least toxic waste, it required 13 to 18% to kill fish. The tailings effluent required from 1.3 to 3.9%. These averages of course vary. You can tell by visual observation that there was a difference in the samples, so the ranges I have given include several tests. Some of these are composite samples and some of them grab samples, but an attempt was made to select strong samples and weak samples on a grab sample basis.

After the Median Tolerance Limit was established we tried to determine the volumes of water which would be required to keep the fish alive in the stream. In doing this, we applied an application factor of about one-third (1/3). In other words, three times the volume of water which would kill (the volume of water that actually occurred from the mill) would have to be made up with dilution water in order to protect the fish, and yet a conservative application factor of one-third used.

* The flow of organic raffinate from the mill was about 32 gallons per minute. Using this as a basis and a toxicity of .09%, which was the most toxic, it would require a dilution volume of 79 cubic feet per second. The Vanadium filter wash which had a flow of 52 gallons per minute, based on Median Tolerance Limit of .82%, would require 14 cubic feet per second. The primary tailings which was the least toxic, would require less than one cubic foot per second of dilution water. The tailings pond effluent required a dilution volume of about 11 cubic feet per second.

* Now, to sum up the total requirements of the main effluent consisting of these separate effluents, using a Median Tolerance Limit of .44%, it would require 136 cubic feet per second to dilute the waste, and the tailings pond would require only a fraction or 11 cubic feet per second.

To summarize the two studies, the stream study clearly indicated that the chemical wastes from the mill nearly wiped out the organisms which could live in the stream a short distance below the mill, with gradual recovery. At the State line there was a very definite lack of organisms to serve as fish food in the stream. The bioassay studies indicated that mill effluents were toxic to fish and that the dilution water afforded at the time of the study, at least, was not sufficient to properly protect the fish life in the stream.

Note: These figures do <u>not</u> include the application factor of three, and hence do <u>not</u> indicate that 290 cfs in the river was inadequate. See 2nd paragraph on page 94 of Report. ECT.

MR. STEIN: Thank you. Is Doctor Tsivoglou here?

VOICE: He was called to the phone --

MR. STEIN: Mr. Anderson, while Doctor Tsivoglou is coming back from the telephone, perhaps we can take this opportunity to ask you some questions. Generally, we let the conferees go first, but in view of this unusual procedure, let me ask a question or two.

Do I take it, below the mill you expect to find a depleted fish population?

MR. ANDERSON: Based on toxicity studies, I would say it would be very difficult for fish to survive below the mill when the stream flow is low.

MR. STEIN: Would you think that if there were no toxic material in the water below the mill, that the fish would survive in that stretch of the stream?

MR. ANDERSON: That is true. In fact, at times of high water I am led to believe that considerable fish can be found below the mill. Of course, they migrate upstream during periods of high water and inhabit this area. As a matter of fact, some small fish were obtained below the mill during part of this study.

MR. STEIN: What fish would be indigenous to this area -- could live in the stream?

MR. ANDERSON: Of course the rainbow trout is stocked in these streams and is the preferred fish. Naturally, many suckers inhabit the stream, and of course many of the small fish such as the dace, sculpin, and minnows.

MR. STEIN: Now, Doctor Tsivoglou is back, perhaps we can proceed. We can continue with questions on the whole report later. Doctor Tsivoglou.

DOCTOR TSIVOGLOU: As a summary of this material; let us say a lot of this material is of research interest, but has to come to a practical point. What we tried to do was estimate as well as possible any human exposure to radium and strontium-90, as such, in the area. We did our best, and let us say these represent estimates. We believe they are reasonably correct and we believe they are reasonably conservative. As I go through them you will see that there are some questions, but I do not believe that they are major.

We want to estimate, in essence, the amount of radium intake and the amount of strontium-90 intake in the various population groups in the area. I want to emphasize here that strontium-90 has nothing to do with the Vanadium Corporation of America mill at Durango. Any strontium-90 that happens to be around is from fallout from nuclear weapons tests. However, as we pointed out before, the amount of strontium-90 that is around affects the amount of radium that should be around. Let's put it that way.

Now, I said several population groups, and what these amount to are this:

We wanted to estimate exposure first of all in the Durango area as a control location; in other words, among individuals who did not use water or foods affected by mill operations. We wanted to estimate exposure or daily intake also among individuals in New Mexico. One population group would consist of those individuals using the river water in its raw state, and of a quality as indicated by data at the State line.

Another group, of course, is individuals using water from the Aztec or Farmington water treatment plants. All of these groups in New Mexico include some people who would use primarily for food, crops grown locally. Other individuals in the area undoubtedly use crops that come in commercially from other areas. It is impossible to know how many people live primarily on crops grown in the area but there is not much question that some do.

With these reservations in mind, we made estimates of the exposure of people, of the daily intake of radium and strontium-90. We had estimates on the basis of river flows as we found them in 1958 - this was a two-month period. We were concerned with the average annual exposures rather than a short time; and so we went back to the water year 1955-56, largely because this is the last published record of the U. S. Geological Survey. We had data for the entire river flow, that is for the entire water year, 1957-58, but it was provisional data. In other words, we had the recorded flows or gage heights and made our own computations of flow. We were not at all certain that the USGS would agree with us, within the 5%, so we went back to their published record of 1955-56.

I think we can summarize this quickly from the table in the Report, as found in the 1958 survey for the people of Durango. These figures are all fractions of the allowable daily intake. As we said before, for radium that would be 8.8 micromicrograms per day, according to Handbook 52 and Handbook 59.

On that basis, we found that for radium in water supply; the people of Durango would get 0.08 times the allowable daily intake -- in other words, 8%. Their water supply, incidentally, comes from upstream on the Florida River. For strontium-90 in water, these people received about 1% of the allowable amount. Radium in milk and food amounted to about 28% of the allowable amount, and strontium-90 in milk and food amounted to about 22% of the allowable amount.

Now, in the food I should qualify and say this: we did not have samples of all conceivable kinds of foods. We concentrated on the vegetable crops grown in the area. We did not do meat samples -- we did not do several kinds that might be included in the normal diet. We went through a book on physiology and estimated an average diet for people, and estimated on that basis. The diet consisted of leafy green vegetables, citrus fruits, tomatoes, potatoes, sweet potatoes, other vegetables and fruits, milk, meat, poultry and fish, eggs, dried beans, peas, nuts, flour and cereals, fats and oils, sugar, syrups and preserves in various amounts. Now we have no figures for meat, poultry and fish, and in essence, we have assumed zero intake from that source, which probably is close. We have no figures for eggs, and so we assumed zero. We have no figures for nuts, fats, and oils, so all of these items have been assumed to be zero intake.

At Durango, then, these figures added up to say the people there received about 59% of the allowable daily intake of strontium-90 and radium combined, according to Handbook 52.

Against that, we go to raw water users in New Mexico in the vicinity of the State line. As of the 1958 survey we estimated the people there might have received as much as 2.6 times the allowable amount, or 260%, as of the river flows as we found them in 1958. At Aztec the figure was about 160%, and at Farmington about 140% of the allowable intake.

In the water year like 1955-56, which represents an entire year's period; in essence, we found over a two-month period about 8 milligrams per day of dissolved radium passing the State line. Estimated on that basis, if we had a water year like 1955-56, with that figure of 8 milligrams per day, then the resulting exposures would be estimated as follows: at Durango 59%, because it is unaffected; raw water users in New Mexico about 3.5 times the allowable amount; and Farmington about 2.2 times the allowable amount.

We are going to have to estimate further in this sense; in 1958 as of the time of the first meeting, the people from the Vanadium Corporation of America indicated and they told us later also, that they planned to increase the mill capacity. One has to estimate on this basis, that if waste treatment methods were to remain entirely unchanged, then we would have to increase some of these figures by a factor representing the increase in the mill capacity. To put some numbers on this, they estimated to go from about 510 tons per day up to about 700. Now, if they did nothing to change waste disposal processes, and the effluent for instance contained the same concentrations and same proportions, then we would estimate increased water quantities of radium.

In a water year like 1956-56 and with increased mill capacity, and with waste disposal conditions unchanged, we would figure raw water users in New Mexico to take in about 4 1/2 times the allowable amount of radium and strontium-90 combined. For users of treated water; at Aztec about 3.2 times, and at Farmington about 2.7 times the allowable amounts of radium and strontium-90 combined, in the food, water and milk, all added up.

I think that essentially completes the report.

MR STEIN: Thank you, Doctor Tsivoglou.

We will now see if the conferees have any questions to ask. Mr. Gahr, do you have any questions?

MR. GAHR: Not at this time.

MR. STEIN: Doctor Leland?

DOCTOR LELAND: No, but Mr. Caldwell has something to say.

MR. CALDWELL: One of the points you are making here, I believe, has been well illustrated. We are concerned with the total concentration, and this mill waste is simply one source. I mention that at this time as it seems appropriate before we go on that we should sort of clarify our minds. We, here

in New Mexico, are interested in the exposure of our population. Therefore, this is not a case, as I see it, where we are trying to get into conformity with any arbitrary standard. In other words, radiation exposure is a total problem, and in the light of our philosophy of the present times, we should try to reduce that to as much a minimum as possible. So I think that any thought that is given to recommendations should keep that in mind. The AEC Handbook specifications represent a guide. They are maximum, where we want to reduce our problem to a minimum. I thought that should be cleared.

DOCTOR TSIVOGLOU: That is as we understand it also.

MR. STEIN: Mr. Svore, do you have any questions or comments?

MR. SVORE: None at this time.

MR. STEIN: Doctor Tsivoglou, would you say that if the Vanadium Corporation mill at Durango were not there, that the contents of the Animas River (as far as the radioactive material is concerned as it flows down to New Mexico); if used as a source of raw water supply, a source of public water supply, or for recreational purposes, would have substantially less of the radiation content?

DOCTOR TSIVOGLOU: Yes.

MR. STEIN: As I understand it, the report indicates that there are two types of materials coming up. One, chemical; and the other, radioactive material, which the report indicates do affect water uses. The chemical materials affect fish and aquatic life.

DOCTOR TSIVOGLOU: Yes.

MR. STEIN: Would you characterize these materials? Maybe I can do this in a lay fashion. See if I am right. Would you say that the chemical materials can be characterized as, 1) organic raffinate, and 2) the iron aluminum sludge from the mill?

DOCTOR TSIVOGLOU: I think Mr. Anderson indicated that the most toxic waste screened was the organic raffinate, as we found it. We did not do a bioassay on iron aluminum sludge at the time. The figures we have indicate that probably it did have substantial toxicity. We did everything but that, and it seems that it must have had a fair amount of toxicity.

MR. STEIN: Right. Now, the radium discharge from the mill (and see if I understand this) is contained both in settleable solids coming from the mill, and in dissolved form in an effluent.

DOCTOR TSIVOGLOU: Yes.

MR. STEIN: One more question. In your investigations there, did you ever see anyone swimming in that stream below the mill?

DOCTOR TSIVOGLOU: Yes -- a few hundred yards downstream below the mill. They were swimming, however, on the opposite side of the river.

MR. STEIN: Do you think the water had a chance to mix?

DOCTOR TSIVOGLOU: In the evidence from the biological study, that is, the removal of organisms; on the mill side of the river we found no organisms, in the middle we found a few, on the other side we found substantial numbers; -- so that the effluent could have been only partially mixed.

MR. STEIN: Thank you, Doctor Tsivoglou. Mr. Gahr, may we call on you now for Colorado's presentation?

MR. GAHR: Yes, Mr. Chairman, to clarify the procedure, would you like at this time for us to determine the people whom we have invited? If you prefer, I can do it quite easily.

MR. STEIN: You can introduce the people. If they are going to make statements, you may determine that and we can call on them.

MR. GAHR: The Colorado State Department of Public Health with the help of the regional Public Health Service Office, attempted to invite certain agencies and individuals whom we thought might have an interest in this matter. They are briefly as follows: the San Juan Health Department, Doctor Warner is present. Doctor Warner, do you plan to make a statement?

DOCTOR WARNER: I will make no statement.

MR. GAHR: The City of Durango - Mr. Reavis, City Engineer, is present in the audience at this time.

MR. REAVIS: I will make a very brief statement.

MR. GAHR: The City of Silverton - is anyone present in the audience from Silverton? I don't think, Mr. Chairman, anyone is here representing Silverton and we have no information indicating they would be present.

The Vanadium Corporation of America has a representative present. Mr. Brinker, Assistant Vice President, Western Branch of the Corporation, will present a statement, and will introduce or call on representatives as he chooses.

From the U. S. Geological Survey, I believe Mr. Barker is here but it is my understanding he will not make a statement. Mr. Scott is present -- do you have a statement?

MR. SCOTT: No statement.

MR. GAHR: From the Bureau of Reclamation, Mr. C. T. Wright of Salt Lake City is here. Mr. Wright, do you plan to make a statement?

MR. WRIGHT: None.

MR. GAHR: Also representing the Bureau, from Durango, Mr. Crabtree; do you plan to make a statement?

MR. CRABTREE: No statement.

MR. GAHR: Mr. Darcy George, AEC Operations Office, Grand Junction, is present. Mr. George, do you plan to make a statement?

MR. GEORGE: I have no statement.

MR. GAHR: Is there anyone else?

MR. ROGERS: I am Lester Rogers from the Washington Office of the Atomic Energy Commission. I plan to make a statement on behalf of the AEC.

MR. STEIN: Before we decide on how we want to do this -- if you are from the Washington Office it may be wise for both states to complete their statements before we call on the AEC. I think it would probably be more meaningful that way.

MR. GAHR: Is there anyone that we may have missed? I believe not. That should include all persons and agencies who were asked to attend.

For the State of Colorado, then, we have this statement. It was prepared by Mr. Fred Ritter, Public Health Engineer of the Colorado Department of Public Health, during the month of May, 1959. If I may, I would like to read this.

"An inspection of the Animas River drainage area upstream of the Colorado State line was made in May, 1959, to determine the sources of non-radioactive pollution of the Animas River.

"The Animas drainage area begins above Silverton, Colorado, and extends south into New Mexico. In Colorado the basin is approximately seventy-five (75) miles long and twenty-five (25) miles wide.

Sources of Pollution

"Pollution in the Animas River results from domestic sewage and industrial wastes which receive varied degrees of treatment.

"Silverton, Colorado (population 700) (1300 summer) discharges domestic sewage without treatment into South Mineral Creek. This point is approximately three hundred yards above where it empties into the Animas River. There are approximately 600 people connected to the sewer system. A trench type city dump is on the Animas River bank at the south edge of town, approximately 75 to 100 yards from the stream. This is a type of sanitary landfill.

"The assessed valuation of Silverton is $560,663 and the town has a bonded indebtedness of $3,000.00."

At this point, for the purpose of the record, we should like to add some additional information in the form of what we will call Appendix A.

(See Appendix A)

"The Shenandoah Dives Mill, which has not been in operation for several years, is located about a mile north of Silverton on Boulder Creek approximately one quarter mile from where it empties into the Animas River. High water in Boulder Creek cuts into the tailings pile taking an undetermined amount of tailings downstream toward the Animas River. During operation, the Shenandoah Dives mill processed complex ores. (Complex ores are Copper (Cu), Zinc (Zn), Lead (Pb), Silver (Ag), and Gold (Au).

"The Shenandoah Mill under a new name, the Shenandoah Limited, is expected within the next year to begin milling of complex ores again. Its capacity is planned to be seven hundred and fifty (750) tons of ore per day. The tailings ponds are planned to be at the site of the old tailings piles by Boulder Creek.

"The Pride of the West Mill, about four miles north of Silverton, has shut down for an indefinite period of time. The mill did custom milling of complex ores.

"Hermosa Creek enters the Animas River from the west about seven miles above Durango. Approximately twenty-two miles up Hermosa Creek the Vanadium Corporation of America has an underground vanadium mine which is not in operation at this time. There is no contamination entering Hermosa Creek from the mine.

"Lightner Creek enters the Animas River from the west at the southwest edge of Durango about three hundred yards above the Vanadium Corporation of America mill. The Good Hope Mine is approximately twelve miles up Lightner Creek, but is not in operation at present. Poscoelite was taken from the mine. The mining was a semi-surface operation with one shaft approximately 500 feet deep.

"Durango, Colorado (population 11,500) has four municipal septic tanks and two Imhoff tanks, the effluents of which go directly to the Animas River. The Clover Rich Dairy, which processes approximately one thousand (1,000) gallons of milk per day, a garage and offices occupying the same building, have a private septic tank discharging into the Animas River.

"Plans and specifications for a complete sewage treatment plant have been received by the Colorado State Department of Public Health and the U. S. Public Health Service, from the City of Durango. Construction is expected to be completed and the plant put in operation by July 1, 1959. Installation provides connection of all lines, both municipal and private, which are now discharging into the river within the city."

We would like to add at this point, Appendix B, which will provide current information of interest, which is very recent. Likewise, I think Mr. Reavis' report will bear on the subject.

(See Appendix B)

"South and east of Durango one mile up Horse Gulch, the city operates and maintains a landfill operation for refuse after a burning operation. The operation is such that no trash is carried to the river as a result of runoff.

"Immediately south of Durango is a small industrial area including a lumber mill and meat packing plant. Each industry has its own sewage or waste disposal system with no direct lines to the river."

That completes our statement.

MR. STEIN: You have Appendix A and B?

MR. GAHR: Only in rough draft.

MR. STEIN: Do you want Appendix A and B to appear in the record?

MR. GAHR: Yes, I do.

MR. STEIN: They will appear as read, but you will have to get them in to Mrs. Price to get them done very shortly.

MR. GAHR: I will do that.

MR. STEIN: Do you have any questions, Mr. Caldwell? Mr. Svore? I have just one. Would you say, in your opinion, that the municipal waste disposal and mining operations around the Silverton area, do not at the present time have a significant interstate effect?

MR. GAHR: At the present time I would say they do not have a significant interstate effect, because of the distance they are from the State line. If I might, Mr. Chairman, I would like to add that the State Department of Health (State of Colorado) has a new law, and we are already working with the City of Silverton and are hopeful that this will result in sewage treatment facilities. This will appear in our statement so I guess there is no need in taking the time now.

MR. STEIN: Thank you. Mr. Gahr, would you call those people who have indicated that they wish to make statements?

MR. GAHR: Yes. Mr. Reavis, City Engineer for Durango, will you please come up and present your statement?

MR. STEIN: Mr. Reavis, would you identify yourself? Would all people making statements, and the conferees who presumably are identified, identify themselves before speaking?

MR. REAVIS: I am Mr. Reavis, City Engineer, Durango, Colorado. As I indicated, my statement will be very brief. It is more in the form of an up-to-date resumé of what the City of Durango has done to alleviate the pollution problem caused by its domestic sewage.

As is indicated in the Colorado Department of Public Health report, the City started a year ago planning toward complete treatment facilities for the City of Durango. The septic tanks and Imhoff tanks that we had in operation at that time were flowing directly into the Animas River. We have completed a trunk main and have connected all these Imhoff tanks and septic tanks into the trunk main. We have 99% completion on the complete treatment facilities at Durango. The plant at the present time is in operation. Domestic sewage from the city is being completely treated at this time and the effluent from the plant going into the river.

I think this probably is a brief enough resumé. What I wanted to do was bring you up to date on the matter.

MR. STEIN: Do you have any questions, Mr. Caldwell?

MR. CALDWELL: No.

MR. STEIN: Mr. Gahr, any questions?

MR. GAHR: This is what is commonly known as a complete or primary and secondary sewage treatment plant?

MR. REAVIS: Yes, it is the trickling filter type.

MR. GAHR: All connections have been made, as far as you know?

MR. REAVIS: They have been made with this one reservation; that they are making the final connection today, of the septic tanks. The remainder of the tanks have been connected.

MR. STEIN: Would you tell us for the record, what percentage of reduction you expect to get in terms of B.O.D. when this plant is in operation?

MR. REAVIS: We have run no tests as of the present time; in fact, our laboratory equipment has been ordered and has not come in.

MR. STEIN: Do you have an opinion on that?

MR. REAVIS: I have an opinion -- any plant of this type that is being operated efficiently, that is not being operated haphazardly, should get 90% reduction. My opinion is that it should be between 90% to 95%.

MR. STEIN: Thank you. Mr. Gahr, do you have any others?

MR. GAHR: Yes. Mr. Chairman, at this time I should like to ask Mr. Brinker, Assistant Vice President, Vanadium Corporation of America, to come forward and present his statement, and to present any others in his party he wishes, afterward.

MR. BRINKER: I am the representative of the Vanadium Corporation of America, and we are very glad to be here today to make a progress report and to discuss with the other conferees and guests the pollution problem of the Animas River.

"This is a statement by the Vanadium Corporation of America, Durango, Colorado, for the Second Conference on Interstate Pollution of the Animas River, to be held at Santa Fe, New Mexico on June 24, 1959.

"The Company operates a uranium-vanadium processing plant at a millsite on the west side of the Animas River, just south of the city limits of Durango.

"At the First Conference held on April 29, 1958 in Santa Fe, it was decided that a survey be made by the Public Health Service of all matters relating to the pollution of the Animas River. This survey has been made and we received on June 6, 1959 a report of this survey.

"The Company has always recognized the problems relating to pollution of the Animas River and has been seriously concerned as to the radioactivity of the water in the river. It is used both at Aztec and Farmington, New Mexico for domestic water supply. For this reason, several times before we received the Report of the Survey, inquiry was made of the Public Health Service as to the radioactivity of the water at Aztec and Farmington, and we now note with interest that both water supplies were well below the 4.0 standard as presently established.

"We feel that the Report of the survey is accurate, complete and well formulated. We wish to express our appreciation of a job well done. A few comments will be made on parts of this Report later in our statement.

"The Company has been diligently attacking this pollution problem with the expenditure of a large sum of money and much effort. Some of this expense can be charged to the plant because of saving more uranium and vanadium, but some of it is entirely chargeable to better water in the Animas River below the Company plant. Below are some of the things already accomplished:

Laboratory work on settling tests.
Laboratory work on decontamination tests.
Installation of filter plant for scrubber mud, instead of ponding.
Elimination of acid neutralization "sludge" solids in effluent.
Improved operation of soda leach pond for better elimination of solids in effluent.
Improved operation of lower settling pond or acid leach tailings for better elimination of solids from effluent.
Design and construction of dual settling pond operation with decontamination treatment plant between ponds.
Relocating high tension power line to make the above operation possible.

"The National Lead Company working for the U. S. Atomic Energy Commission during the last year has published very valuable data on the decontamination problem and we have been informed as to this work and some of our effluents have been tested in their work.

"Within a few days the Company will have in start-up operation the dual settling pond operation with treatment plant which we are calling Effluent Plant. The first plans of this plant were made over a year ago. Our plan of operation includes a primary settling pond for removal of most of the solids in this pond, a flexible plant to treat for decontamination the overflow liquor from the primary settling pond, the treated liquor then going to a secondary settling pond into the river. To do this it was necessary for us to reactivate our high tailing pond with the moving of power line and relocation of decants and launders. The treatment plant consists of an agitator tank and mechanism, mixing tanks for barite, lime and separan with feeders and necessary pumps. Plans also include a limestone grinding plant if later required. There are now four effluents from the plant operation; (1) acid leach tailing liquor, (2) raffinate, (3) soda leach tailing pond overflow, and (4) vanadium precipitation barren liquor. Although (3) and (4) are low in radioactivity it may be advisable at times to combine these with (1) and (2). Future plans also include the possibility of discharging effluents at only one place with automatic metering and sampling at this one place. In all of these operations the Company must balance the beneficial results to the Animas River water against the allowable expense to the operation.

"During the time the survey was being made in the summer of 1958 the Company plant at Durango was in a state of change in terms of expansion and process development; therefore, the survey as made at that time may not reflect the actual conditions as they exist at the present time or as they will be with the decontamination plant in operation. Tonnage treated now is 700 tons per day

as against 514 last summer. Since that time plant conditions have stabilized and we have made the improvements relating to pollution as stated above.

"The Report of Survey states on page 44, that it was estimated that 14.9 tons of solids were entering the Animas River and that these solids were a source of continuing radioactivity for the water in the river. By making the improvements, not including the dual settling ponds with Effluent Plant just starting up, the solids for a period of over two months have been 2 tons per day from final tailing effluent, and 2 tons per day from soda leach tailing pond overflow, making a total of approximately 4 tons per day as against 14.9 tons per day at the time of the survey. This is a reduction of 73% and this with the increased tonnage. With the operation of the dual settling ponds with treatment plant this should be reduced still further. A portion of any solids discharged from the plant into the river accumulate in part along with other non-radioactive solids in the bed of the Animas River. However, this is only an accumulation from one high water period to the next and not over one year. An examination of the stream bed after the June high water shows a practically clean bed which has been scoured by the sand content of the high water. These solids move down the Animas to be mixed with the millions of tons of sediments in the San Juan River. The above is our observation only, and is not advanced as an argument for discharging solids from the plant into the Animas River.

"The flow diagram of the Company plant shown opposite page 36 in the Report is correct as to the time of survey. A tailing pond for final tailing is not shown but the tailing pond was mentioned in the description and must have been omitted by error in the flow diagram. The acid purification or neutralization step is now eliminated, all acid liquor being treated by solvent extraction. The dual settling ponds with effluent treatment plant would have to be added to the flow diagram now.

"The dissolved radium content in the water samples is used as approximate measure of radioactivity of the water.

"The unit used in the Report for reporting dissolved radium is micromicrograms per liter of water. This is a millionth of a millionth of a gram of radium per liter of water. The determination of this small amount of radium in water is a difficult analysis to make and our experience has shown that many times results do not check either in the same laboratory or between different laboratories.

"In addition to the above there is great variance in results which we believe may be due to the method of sampling and preparation of the samples before determination in the laboratory. This is particularly true with any water sample containing solids or water of a pH value. We believe that some of the erratic results can be more easily explained by this sample error rather than the erratic radium content.

"The Atomic Energy Commission's 10-CFR-20 Standards for Protection against Radiation specifies for radium a limit in water in unrestricted areas of 4 micromicrograms radium per liter of water. It is our understanding that there are some current recommendations now under consideration to change this to ten (10) micromicrograms radium per liter of water.

From the Report of Survey we are listing below some of the Sampling Stations with the results as given in the Report:

Station 1 — Animas River above VCA plant.
13-A — Plant Effluent from pond to Lightner Creek.
13-B — Plant Effluent from pond to Animas River.
18 — Plant plant Effluent to Animas River.
2 — Animas River 2 miles below VCA plant.
5 — Animas River at Colorado-New Mexico State Line.
7 — Animas River water at Aztec Water Treatment Plant.
8 — Animas River water at Farmington Water Treatment Plant.
9 — Animas River water at Shiprock Water Treatment Plant.

Results below are all in micromicrograms per liter of water

	Average	Range
1	0.6	0.3 to 1.0
13-A	180.	58. to 440.
13-B	431.	140. to 682.
18	103.	44. to 160.
2	12.6	9. to 19.
5	7.6	6. to 10.
7	3.4	2.3 to 4.7
8	2.8	1.6 to 3.4
9	0.4	0.1 to 0.7
Downstream Farm Irrigation Water	3.7	2.2 to 5.0

"From the above results it is apparent that the radium content of the Animas River water continues to drop from Durango to Farmington where it flows into the San Juan River. We believe this drop cannot be explained by dilution or by irrigation use and return. The Animas River water is alkaline with a pH at Durango of 7.9, and this pH is little changed downstream. We do not find in the Report a record of the pH at downstream stations but no doubt they were taken and we believe would show little change from the 7.9 pH upstream. With the high dilution rate with plant effluents of from 250 to 1 and higher, we believe that the radium is precipitated by the alkaline water itself as it flows from Durango to Farmington.

"Dissolved radium that appears in the plant effluent originates in the ore processed in the plant. The acid leach process dissolves radium from the ore in the range of 2 to 5% of the total content of the ore. A small amount of the radium goes into the finished products in acid leach process which results in most of the dissolved radium being contained in the effluents. Recycling or evaporation only builds up the grade of the effluent in radium. This dissolved radium may be disposed of by (1) dilution with surface waters or rivers and carried downstream, (2) by precipitation into porous ground where it later enters a stream or is co-mingled with underground water supplies, or (3) by precipitation and storage in a settling pond. In our Company treatment plant just starting up, we expect to precipitate a substantial part of the dissolved radium and store in the secondary settling pond. We believe that this lowered radium content of the effluent should lower the radium content of the Animas River water proportionately. April low water river samples at the State line show about

the same radium content as last August survey even with increased mill feed.

"The chemicals used in the Mill Process as shown on page 43 are correct with the following exceptions: Kerosene 270, Tributylphosphate 190, and Trilauryl amine 94.

"Since July of last year we have been operating a solvent extraction process using several organic chemicals dissolved in kerosene. There is some loss of this organic and part of this enters our plant effluent in the mill. The dual settling ponds with treatment plant will treat our raffinate and should trap most of this organic and prevent its entering the river. This problem has been given consideration in the design of the operation. This organic is expensive and efforts are continually being made to reduce the loss of this organic in the plant. The present loss is much lower than previously. From page 95 of the Report we quote, "it appears from these results that Animas River flows of 600 cfs at Durango would be required to provide sufficient waste dilution to protect the aquatic life of the stream." Since the average flow of the river is well above 300 cfs the same result should be obtained if the deleterious waste material were reduced by half. This should be accomplished with the new plant.

"Summary of Estimated Exposures in Fractions of the Allowable Amount is noted on page 105 of the Report. We do not question the radium and strontium-90 figures in the water for the period of the survey. We do question the factor for increase due to mill expansion and also whether the figures without this factor apply to conditions which will result from the operation of the new treatment plant. As to the matter of estimated exposures from milk and food, we are not qualified to make any statement on the detailed data submitted in the Report."

That concludes the written report.

Yesterday we received from the National Lead Company who are contractors for the AEC, a report from laboratory work which was done by them at the Winchester Laboratory on some of our recent effluents. At this time I would like to have Mr. Beverly make a statement as to the results of these tests. Mr. McArthur, also of National Lead, is here, but Mr. Beverly visited our new plant at Durango yesterday, and I believe could make a very brief statement as to the tests, also the plant and what might be expected.

MR. STEIN: Mr. Beverly.

MR. BEVERLY: As many of you know, for the past year the National Lead Company has been doing work on developing methods for radioactive decontamination of uranium mill tailings. More recently, we have been doing some work on the Durango tailings. We found for acid mill tailings, we can get effective and very economical operation by either barium sulphate treatment or neutralization or combination of both. As a result of our recent tests with both barium sulphate treatment and neutralization treatment, I would say that it would be very reasonable to expect a radium decontamination in the range of 75% to 80%, using the method they had planned at Durango. Our conception was that the reagent consumption and the method of treatment were the same as they have planned to use at the VCA mill.

MR. STEIN: Thank you. Do you have any questions, Doctor Leland?

[illegible]

MR. CALDWELL: No questions now.

MR. STEIN: Mr. Cahr?

MR. CAHR: Mr. Brinker, am I right in assuming that you felt that with what you have done, you are reducing the total wastes by about three-fourths over what previously had gone into the river?

MR. BRINKER: Yes, in the solids. We feel that the plant during the last two or three months has reduced the solids by about 75% -- 73% as stated in the statement. This has been accomplished by better pond operation, watching it carefully, spending some money on re-arranging the decants for the overflow, and some spent on chemicals to settle the solids. As far as the solids from our tailings plant discharged into the river; we feel that that problem is solved and that will not be a serious problem in the future.

MR. CAHR: Mr. Brinker, will that include the dust that seems to blow off -- there has been some concern about that -- is that part of the solid wastes that you are keeping out?

MR. BRINKER: No. I am talking about the tailings pond solids that go into the river with our effluents.

MR. CAHR: As a liquid --

MR. BRINKER: That's right.

MR. CAHR: Would there be any proper value to all of us if we, in the future, had split samples of the mill on these effluents that you could have analyzed?

MR. BRINKER: We are taking composite samples on our effluents on a monthly basis, and we would be glad to split those samples and send them to anyone who wants to try. I might add that the radium determination now is very difficult. We have tried to do some radium analyses ourselves -- we have given it up. We have sent our samples to the Health Department; we have sent them to National Lead, and we feel National Lead's results are good; and we have sent them to independent laboratories. There are now about fifteen laboratories that are set up for radium determinations, but we have great difficulty in getting the same results from two different laboratories.

MR. STEIN: Do you have any further questions, Mr. Svore?

MR. SVORE: Mr. Brinker, would you care to elaborate a little more on just what you mean by the beneficial results to the river versus the cost of the plant?

MR. BRINKER: In all these matters; for example, to get this dual settling pond operation plus the treatment plant into operation, we have spent over $30,000. As I stated in the report, we have been rewarded by some effort by increasing our recovery of uranium and vanadium. Most of

that expenditure is entirely to eliminate pollution, to make the Animas River better for everyone, ourselves included.

MR. SVORE: Do you have any means of determining the beneficial results to the river? I am talking about monetary aspects.

MR. BRINKER: That is very difficult -- I would be in no position.

MR. SVORE: I assumed you were balancing additional costs that may result to the plant, as against the beneficial results in the river. Do you have any figures as to what value it was to the river?

MR. BRINKER: The only monetary consideration is our own expenses. As far as the monetary consideration to the river; if Aztec people have water with less [illegible] in it, I would be in no position to judge whether that is worth one amount of money or another amount of money. As to people swimming and fishing, it would be hard to put a monetary value on that.

MR. SVORE: You indicated in your report, Mr. Brinker, that there was a possible change in the Standards from 4 to 10. Was it your feeling that this should become the ceiling instead of 4 that we now have?

MR. BRINKER: The committee that worked on that spent several years and very large amounts of time. Just as a comment, the first Handbook came out with a figure of 40; then somebody divided it by 10 and had 4; and now they are multiplying 4 by 2½. As to my opinion on any figure, regardless of what it would be, would be useless.

MR. SVORE: Do I interpret that to mean that the company is not necessarily shooting at 10?

MR. BRINKER: We want to make it as good as possible, with reasonable expansions. We have to consider to save --

MR. SVORE: This is an academic question, but I don't believe you brought out the size of your settling tanks. I am not aware that I have seen it any place.

MR. BRINKER: The top pond is about 500 feet in the longest direction, (it is an odd shape) by 150 feet. The bottom pond is about the same area. They are large ponds, as far as tailings ponds are concerned.

MR. SVORE: How deep are they?

MR. BRINKER: Well, we build them up with sand and solids. The liquid part is fairly shallow in both of these ponds; maybe in some places it might be 10 feet, then around the edge only a few inches.

MR. STEIN: Thank you, Mr. Brinker:

I would like to say, for the record, that it is my understanding that the report prepared by Public Health Service could not have been done

without the complete cooperation of the plant and full disclosure of plant operations and all other pertinent materials. We are grateful for that.

I think we should take a fairly unusual step in order to try to get at the issue here. A good portion of this report of yours raises questions concerning the report prepared by Doctor Tsivoglou and his group. I wonder, do you want to address yourself just to these points, if you think it is appropriate, or do you just want to let these differences stand for the record?

DOCTOR TSIVOGLOU: I might make one remark; I don't think that we are talking about real differences in thinking. As I understand, Mr. Brinker's concern was that we may not have gotten some of our information during the normal operation periods of the mill, but that you were in a state of change. This 14.9 tons bears this out; that we thought might be unusual rather than usual. I don't think we have any argument with this.

The other, I understand your concern is to project some of these figures into the future; is the case that the number of them as we may have found them last August are not so at the present, and will be better in the future. We have no argument with that, either.

MR. STEIN: I didn't think there was an argument. One more point -- Is Mr. Anderson here? This is always the kind of reasoning that bothers me, and I hope it is true because the scientists never seem to work this way. I am referring to Mr. Brinker's statement where he states, "On page 95 of the Report, we quote, 'it appears from these results that Animas River flows of 600 cfs at Durango would be required to provide sufficient waste dilution to protect the aquatic life in the stream.' Since the average flow of the river is well above 300 cfs the same result should be obtained if the deleterious waste material were reduced by half."

Now, does that follow? If it does, this is the first time we can do something by simple arithmetic and I am real happy. (Laughter)

MR. ANDERSON: I think these figures have been based on the data presented in this report. This 600 cfs was based on dilution volumes required to protect fish in the river. There is a table on page 95 which shows dilution volumes required for these different wastes. The main effluent is shown 7 to 193 cfs. Roughly, 200 second feet was multiplied by 3 to obtain the 600 cubic feet per second. This was the worst condition based on the tests. I would comment, however, that the average flow of the river is probably an average annual flow, and that during dry periods the flow is much less. In other places in the report you have figures to show the 7-day period, which we found to have a range of 140 to 150.

MR. STEIN: May I make one comment, then. In this report you say, "Inquiry was made of the Public Health Service as to the radioactivity in the water at Aztec and Farmington and we now note with interest that both water supplies were well below the 4.0 standards as presently established."

Now, maybe I have a misunderstanding here. This is an effluent coming out of an installation subject to AEC regulations, going into a water course before these installations are licensed, it is my understanding that careful consideration is given to site location. The fact that the content at a water intake is 3.4, as it is at Aztec, to my mind I don't know that that meets the question because I doubt that the AEC would license an installation above a water intake putting out an effluent of 4.0. This is for an effluent, also taking into account the fact that the AEC carefully selects and regulates the site. If I am wrong on that, I can be corrected.

MR. DRINKER: Here is one paragraph that might have some bearing on that. We believe it does. It is in the Regulations Part 20 -- Concentration in Effluents to Unrestricted Areas: "There may be included in any application for license or for amendment of a license, proposed limits upon concentrations of licensed and other radioactive material released into air or water in unrestricted areas as a result of the applicant's proposed activity. Such application should include information as to the anticipated average concentrations, and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed amendments if the applicant demonstrates that it is not likely that any individual will be exposed to concentrations in excess of limits specified in Appendix B, Table II, of this Part."

These regulations were drawn with some restrictions and some possibility of effluents being more than 4. Perhaps I misinterpret that.

MR. STEIN: No. I think we are both talking about the same thing; but the point I want to make is that the radioactivity count in a water course of 4.0 does not really relate to the Standards of AEC. The Standards of AEC relate to an effluent coming out at a spot which they have examined from all angles and have decided that is an appropriate spot to put an installation. Now, I don't think that I have heard of any AEC license operation going into business above the intake of a water plant, yet.

MR. DRINKER: Just to explain a little why I put that in there; that was not to explain whether 4 is good or bad, etc., but if Aztec and Farmington had water that was below 4, we felt good about it. If it had been above 4, or above 10, or above 20, we would have felt differently about it.

MR. STEIN: This is the kind of thinking I think we should engage in. As I read the report, the Aztec intake contains radium in the amount of about 10 times as much as would be the case if the mill were not there. Correct me Doctor Tsivoglou, if I am wrong.

DOCTOR TSIVOGLOU: You have a factor of about 3.6 and 0.6 -- you have about 6 times as much.

MR. STEIN: 6 times as much. This is the problem -- and I would feel good about it if it were down to 0.6. Once you have increased radioactivity by almost 4 times at a water plant, I don't think that is anything to feel good about because I have the same problem with these numbers that you had. This is the question: I don't think that we can take the standards lightly on one side and yet point with pride to them on the other. Either the standards are a guide, or they are a hard and fast rule. I think the object is to keep the radioactive level down as far as possible, using reasonable methods. We both agree on that; I don't think there is much disagreement.

MR. DRINKER: I might add one other thing. We have had numerous radium assays in the water above Durango, and we never did get any as low as the report. We have had them above Durango as high as 3 and 4 on certain samples, and yet at Aztec they were 3.5; so I would disagree with this 5 to 6 times the radium content of Aztec due to our mill.

DOCTOR SVYCGLOU: The data we have in the report will range from 0.3 to 1.0 above Durango. These represent eight weekly composite samples (consecutive weeks) in which a daily grab sample of water was taken, put in a jug and composited for a week, and the assay was done on the weekly composite. The same thing is true at the water plants. If we were to have analyzed the individual daily samples, let us say it is possible that we might have gotten an occasional higher result. How much higher, I don't know. The data represents a two-month period of daily sampling. We have no results above 1.0.

I think, among other things, this may relate to how the sample is analyzed and how it is prepared for analysis; in a sense that we used a millipore filter to separate out the solids. For example, if you left a few suspended solids in the sample, in preparation, you could get a higher reading result. I don't know if you want to go into these details as to the reasons why there may be such differences.

MR. STEIN: I think Mr. Svore has a question.

MR. SVORE: Maybe I missed a point here, but I want to go back to a point you brought out, Mr. Stein, about lowering the computation 50% and thereby letting 300 cfs take care of it. I did not catch whether or not, or how far below the 50% the company planned to go.

MR. DRINKER: We believe, and I think the report shows, that as far as fish and aquatic life are concerned; the solvent extraction organic is one of the deleterious materials. We are hopeful that we can reduce that as far as 90 to 95% over what it was when we started the plant. We started this plant last July, and when they took the samples it was in the early stages. It was something new and no one else had done the job that we are attempting to do. This organic material costs us $1.00 a gallon. We are very particular about attempting to recover all of that, if we can, in our own plant, and keep it out of the effluents entirely. We are hopeful that we will keep a good part of it out of the effluents -- keep it in the plant. This new dual settling pond arrangement, I would say, should get 80 to 90% of what we get into it. So that 50% I think is a low figure, as far as we are concerned, as to what we have hopes of.

I took the 50% because 300 cfs is a reasonable flow for the river. It gets down to 178 for the low water; but there is terrifically high water, and 300 isn't even a normal yearly average. 500, and something, is the yearly average. So we took the 300 -- they said it took 600 to keep the fish and plant food alive, so if we get out half of it we should do the job. We are hopeful that we get out 95%.

MR. STEIN: Thank you, Mr. Drinker. I think you will be permitted to stay (indicating at the table), because I am sure we are going to come back to you for some advice and consultation later on.

MR. [illegible]: I would like to add, to any interested parties, from the various agencies in New Mexico; we would like to see you in Durango, we would like to show you the problem and to show you what we are doing.

MR. STEIN: New Mexico, do you have a statement?

MR. CALDWELL: We want to say that we are very gratified that the survey was held. We think the results show the need for having a survey of this nature. We think the solution should be practical, recognizing the responsibilities and rights of both sides. I would like to emphasize again, you have brought it out and we discussed it briefly before; we feel, too, that we should strive as a goal to hit the 0.6 figure in the water at Aztec. That should be our goal. We think the solution should be practical and fair to both sides, but what we believe is a good working proposition.

MR. STEIN: Do you have any comments or questions, Mr. Gahr, on New Mexico's statement?

MR. GAHR: No, other than to say that we, too, feel that this entire thing has been approached in a most cooperative spirit; everyone has been interested; and everyone has been striving to improve whatever needs improvement. It seems to me that everyone is taking an attitude of trying to eliminate, reduce, and in all ways improve things so that the environment will not be disturbed or damaged any greater than is necessary.

I would like to observe, however, at this time, that I feel in fairness to everyone concerned, we do have to look a little bit beyond some of the specific things we considered this morning. I am not trying to cloud the issue by introducing these other things, but I would like to talk with Mr. Caldwell later on with respect to what could be done in the way of some additional water improvement in the water treatment itself at the plants. This occurs in our own State, also. Thank you.

MR. STEIN: Mr. Svore, do you have any comments on New Mexico's statement?

MR. SVORE: I have none.

MR. STEIN: I think at this time we will call upon the Atomic Energy Commission to make a statement.

MR. CALDWELL: I might say we have invited a number of people --

MR. STEIN: Oh, you have. I am sorry -- this is my error. Would you want to call those people now?

MR. CALDWELL: We invited the Office of the State Engineer. They have a representative here; I don't know whether they want to make a statement or not.

MR. KOOGLER: No statement, Charlie.

MR. CALDWELL: We invited the Department of Game and Fish; is their representative here?

MR. NAVARRE: We have no statement.

MR. CALDWELL: We invited a representative from Utah, and their representative is here.

MR. SUDWECKS: We have no statement.

MR. CALDWELL: We invited Mr. George Marx from Arizona.

MR. MARX: We have no statement.

MR. CALDWELL: We invited various people from the AEC, but I think that will be taken care of in their presentation. We invited representatives from the San Juan County Health Department in New Mexico - do you have a statement, Doctor Bourne?

DOCTOR BOURNE: No statement.

MR. CALDWELL: We also invited representatives from the Public Health Service, Indian Health Division, Mr. Bob Morfitt and Mr. Lester Blaschke.

MR. MORFITT:

MR. BLASCHKE: We have no statement.

MR. CALDWELL: Mr. Christenson is here from Los Alamos; do you have anything to say, Chris?

MR. CHRISTENSON: No statement.

MR. CALDWELL: That includes the people we invited.

MR. STEIN: Thank you, Mr. Caldwell.

Would you go ahead, Mr. Rogers?

MR. ROGERS: Mr. Chairman, I am Lester Rogers, Chief of the Radiation Branch, Division of Licensing and Regulation, Atomic Energy Commission, in Washington. In addition to myself, we have representatives from our Division of Biology and Medicine, our Division of Inspection, our Division of Reactor Development with the Sanitary Engineering Branch, and also I believe there is a representative from the Grand Junction Operations Office. On behalf of the AEC representatives, we are glad to be here and appreciate this opportunity to participate in this conference.

"We recently received copies of the "Survey of Interstate Pollution of the Animas River", prepared by the Public Health Service's Division of Water Pollution Control. Although there may be some specific points in the report that are subject to variation in technical interpretation, the study has provided a considerable amount of useful and needed information concerning the nature and extent of discharges of radioactive effluent from the Durango Mill into the Animas River.

"There is no need for me at this time to identify the specific findings and conclusions of the Division of Water Pollution Control, USPHS, since they are all set out in the report which has been made available to those attending the conference. We note, however, that the report does contain findings that

there may be concentrations of radioactive material in the Animas River above those recommended as permissible by the NCRP for continuous exposure, and suggests a need for reductions in these concentrations.

"It may be of interest to those attending this conference to know that an extensive industrial waste survey of uranium milling operations on the entire Colorado Plateau has been undertaken by the United States Public Health Service at the request of the Atomic Energy Commission. Preliminary information from this survey survey should become available within the next few months.

"Beginning about two years ago, the Commission instructed its Process Development Laboratory at Winchester, Massachusetts to extend its research and development activities for the purpose of developing procedures to reduce radiological hazards associated with mill operations. The objectives of these studies include reductions in concentrations of radioactive material in effluents released from the mills and reduction in radioactive dust concentrations within the mills. These studies are continuing.

"The information developed to date in this program at our Winchester Laboratory has been made available to each of the ore processing mills, to the United States Public Health Service, and to a number of other interested organizations. The reports have been printed and made available for public distribution through the Office of Technical Services, U. S. Department of Commerce. These reports include the following:

(a) WIN-101, December 15, 1958, "Interim Report on Investigation into the Problem of Radioactive Pollution of Uranium Mill Effluents."

(b) WIN-111, April 1, 1958, "Second Interim Report on the Problem of Radioactive Pollution of Uranium Mill Effluents."

(c) WIN-113, December 30, 1958, "Radium Balance in the Monticello Acid RIP Uranium Mill."

(d) WIN-114, December 15, 1958, "Survey of Prevention Techniques for the control of Radioactivity Hazards at the Monticello Uranium Mill."

Additional reports will be published in the near future.

"Among the principal items reported to date are improved procedures for determining concentrations of radioactive materials present in discharged wastes; procedures for purifying waste liquors to remove radioactive materials contained therein; and data as to the extent to which radioactive materials in undissolved tailings are dissolved in water through natural weathering. During the next several months we expect to receive the final report on these studies.

"It is believed that the information contained in the Public Health Survey of Pollution of the Animas River, and the data coming out of the Winchester Laboratory, together with other available information, will suggest means for alleviating the problems under consideration by this conference which are presented by operation of the Durango uranium mill.

"On May 22, 1959, in accordance with procedures established by the Atomic Energy Act of 1954, as amended, and the Commission's regulations, the Commission issued an order to the Vanadium Corporation of America, operators of the Durango uranium concentrating and refining mill. The order cites the company for alleged violation of Commission regulations, and orders the company to submit to the Commission on or before July 1, 1959 a full and complete statement of the measures which the company proposes to take in order to achieve full compliance with the Commission's regulations.

"The alleged violations include principally (1) exposure of employees to dusts containing concentrations of airborne radioactive material in excess of limits specified in Part 20 of the Commission's regulations (Standards for Protection Against Radiation); and (2) release of radioactive material in the Animas River in concentrations in excess of those established in the Commission's regulations. Upon receipt of the reply by the Vanadium Corporation and in light of information developed at this conference and studies conducted by the U. S. Public Health Service, interested State agencies, and the Atomic Energy Commission, the AEC will, in accordance with its established procedures, take whatever steps are necessary to assure that the operations of the Durango Mill will be conducted in compliance with the Commission's regulations and will not endanger the public health and safety.

"In the conduct of our further proceedings under our Act and regulations, we are anxious to keep in touch with the agencies represented at this conference, and to continue our cooperative inquiries."

That completes our statement.

MR. STEIN: Thank you, Mr. Rogers.

Do you have any questions, Mr. Gahr?

MR. GAHR: No, Sir.

MR. STEIN: Mr. Svore?

MR. SVORE: No, Sir.

MR. STEIN: Doctor Leland?

DOCTOR LELAND: Yes, it seems to me, these comments are all well taken, but at the same time I do hope that the policy steps may be delayed until the conclusions of this conference are at least heard by us all.

MR. STEIN: Thank you, Doctor Leland.

Are there any other Federal agencies that wish to make a statement? Are there any other state agencies or public agencies? Is there anyone attending this conference who would like to say something at this point? Mr. Towne?

MR. TOWNE: I am W. W. Towne, U. S. Public Health Service, Cincinnati. In following Mr. Brinker's report, just for my own clarification I would like to know if the ponds in series would receive any of the tailings effluent; or is this 73% reduction, what you are now doing, representative of what will be the final situation insofar as tailings disposal is concerned?

I didn't quite follow what the procedure might be.

MR. [illegible]: In the operation since the survey was put in, up to the present time, for the treatment of the tailings or solids; we have had one tailings pond where we put the solids and the liquid part of the effluent. In that pond the solids settle out, and some solids have been going into the river. Since last summer we have improved the one tailings pond so that we have a bigger settling area. We were able to settle more of the material so that we have reduced it from 14.9 tons (average), which we assumed was correct, to 4 tons, or 73%.

In the new plant which will start up operation in a few days, we [illegible] No. 1 tailings pond which will do the same job as we have been doing. In addition to that, the overflow from the No. 1 pond goes to this treatment plant where we have barite and other materials that we may find to be of advantage. That overflow goes from the treatment plant into No. 2 tailings pond where it will be settled, and some of the solids that would normally be in the river now will be settled in No. 2 pond.

In addition to the barite material, other precipitants that have a radium content will be mostly taken out -- 75 to 80%, or possibly more.

MR. TOMB: Then you expect to further reduce the solids in your tailings.

MR. BRINKER: That is correct. As far as the company believes at this time, it will be no problem for us or for the people in this pollution business. The solids going into the river will be practically eliminated.

MR. SWORD: The dissolved radium, then, with your barite treatment will be reduced about 75 to 80%?

MR. BRINKER: We think that. Winchester tests showed about 80% on some, 75% on others. You can take out 99% of the radium, but the cost would be terrific.

MR. STERN: Let's see if we can go on. I would like to say a word for the much-maligned Standards. I have been in the Standard business myself for about twenty years, and I work on one of the subcommittees with the National Committee on Radiation Protection. The development of standards is always a difficult thing, whether you have drinking water standards or standards for milk, we all always find people taking pot shots at them. These standards generally are developed after careful consideration; they are not fly-by-night recommendations or standards put forth. We try to get the best scientific and administrative thinking and iron out all of the bugs, then put them forth. If you have ever put out of these out you will know that they have to be revised from time to time.

The next point, and here is the point I think people forget; we tend to run down these standards. But we forget the purpose of them. The purpose of the standards is to give a state or regulatory administrator a tool to work with. In the absence of the standards, what would be the situation? It would not be that you could put all the radioactive material or all the waste you wish, any of it wanted in the stream; the answer then is that you could put none, in order to have protection. The standards really are a help

to the people who are putting these materials into the environment, in order to provide a guide for the administrators to have a reasonable approach to the problem. I think this is very often overlooked as to where we would be in the absence of any standard at all.

To get back to the problem of the mill; I think all are agreed that the materials toxic to the fish, such as organic raffinate, should be kept out of the stream in such proportions that they would be toxic to fish and aquatic life.

How long do you think it would take the mill to accomplish this, Mr. Brinker? What would be a reasonable time?

MR. BRINKER: I would say three months -- we should have a good operation.

MR. STEIN: Let me ask the conferees. Do you think that sounds reasonable? Mr. Carr?

MR. CARR: Yes, it does to me.

MR. STEIN: Mr. Svore?

MR. SVORE: Yes.

MR. STEIN: Mr. Caldwell?

MR. CALDWELL: That would be reasonable.

MR. STEIN: The next point where I see we have a little difficulty, maybe I need some clarification, is the radium coming out of the settleable solids. Generally, in a primary plant, in a sewage treatment plant or in a normal operation, we strive for substantial removal of all the settleable solids. Does that sound like a reasonable approach, to get all the settleable solids out and not put any settleable solids in the stream? -- Substantially all? "All" is a big word. We use a word in the standard definition of primary treatment, saying "substantially all" of the settleable solids are removed.

MR. BRINKER: Our goal is substantially all. I am not saying "all".

MR. STEIN: No, I am not saying that. How long do you think that will take -- what a reasonable time would be?

MR. BRINKER: That goes right along with the same three months.

MR. STEIN: In other words, that can be done in three months?

MR. BRINKER: Maybe we should say three or four months.

MR. STEIN: Let's make that four months in both cases.

Let's get to the next point, and that is the dissolved radium which is in solution. Presumably you are planning on the barite process and its modifications which I understand should achieve a 70% reduction in the radium in the dissolved form. How long do you think that process will take?

MR. BRINKER: The same length of time.

MR. STEIN: Four months. Is that agreeable to the conferees?

(All conferees indicated agreement).

MR. STEIN: Let's see if we can summarize the conference now. The summary as you know is open to amendments, suggestions, etc.

I think it is pretty clear that the Animas River is an interstate stream within the meaning of the Federal Law. I think it is also clear that at the present time pollution of these interstate waters is occurring largely due to discharges from the uranium processing mill of the Vanadium Corporation of America, located at Durango.

This pollution deleteriously affects the public water supplies at Aztec and Farmington, individual water supplies of ranches and others who take water raw from the river, affects water used for irrigation, affects waters used for recreation such as fishing and swimming, and affects fish and aquatic life and stock watering.

In addition to the radioactive wastes, there are also discharged certain chemicals which are toxic to fish and aquatic life, and these materials have created conditions inimical to such life.

The conferees agreed that up to this point of the survey, adequate measures toward abatement of this pollution have not been taken. I think the reasons for the delay are:

1) the development of data so we would know what the situation was; and

2) the problems of a new and growing industry in arriving at solutions to its problems.

The conferees have also agreed that the discharges into the Animas River from Silverton, and operations in the Silverton, Colorado area, are not now making a significant contribution to interstate pollution.

The conferees also should take cognizance of the fact that Durango is putting in a sewage treatment plant which will achieve substantial reduction of the municipal wastes by primary and secondary treatment.

The conferees also should take cognizance of the very cooperative way in which the officials of the Vanadium Corporation of America at the Durango mill have entered into a spirit of cooperation to seek a solution to this problem, with the public agencies, the Public Health Service, the Atomic Energy Commission, and the States.

I think the conferees are also agreed that the Durango mill, within four (4) months from today,

1) will install treatment facilities which will reduce organic and other toxic materials deleterious to fish life, so these materials will no longer be discharged into the Animas River in a quantity harmful to fish and aquatic life;

2) that the mill will, in order to reduce radioactive discharges to the stream, provide for substantial removal of all settleable solids; and

3) will treat the remaining radium in solution by the barite process, (or equivalent, or modified processes) to reduce that radium content from its effluent by 70%.

Are there any amendments or suggestions?

MR. SWOPE: I assume that the Public Health Service, industry and the States will re-evaluate the effectiveness of the mill's treatment processes within the stipulated period.

MR. STEIN: After it is done?

MR. SWOPE: Yes.

MR. STEIN: You may want to -- are you satisfied with this, Mr. Cahr? Will you need a report in writing for your purposes?

MR. CAHR: As to the summary?

MR. STEIN: As to what we decided in the summary.

MR. CAHR: Yes.

MR. STEIN: We generally try to follow up on this to evaluate it. Of course we, as in all other activities of the Public Health Service, would want to do this at the request and in cooperation with the States. For example, we would not go into Colorado or any other state and keep on doing evaluations without your full knowledge and consent.

MR. CAHR: May I suggest that perhaps the two states could confer at the end of this period of time, jointly with the Vanadium Corporation of America, and arrive at some definite ideas as to whether or not things have been satisfactorily completed.

MR. CALDWELL: I think I would like to see a follow-up meeting, with the Public Health Service.

MR. STEIN: Could we say this: at the expiration of the four months we, the Public Health Service, will meet with the two states and you can make an evaluation of what has been done, and develop a report. We can undertake the job of developing a report, on the spot. We will make this report available to the conferees and others concerned. Will that be agreeable?

MR. CAHR: Yes.

MR. CALDWELL: That would be agreeable.

MR. STEIN: Is there anyone who wants to say anything at all at this time?

MR. DELHIR: I am Walter G. Belser, Atomic Energy Commission, Washington. I would like to ask Mr. Brister a question or two.

In the next few days or so, the dual settling plant will be in operation along with the chemical treatment plant?

MR. BRINKER: We expect to start today on certain phases of it. We should have the dual settling pond in operation by July 1.

MR. BELTER: And the chemical part?

MR. BRINKER: The chemical part will also be in operation on July 1. We will probably feed some barite in a few days.

MR. BELTER: One other question. Has any consideration been given to the sludge disposal problem -- that settle out of the settling basins? Is there any possibility, from the standpoint of radium coming back out in the effluent?

MR. BRINKER: In all this work at the Winchester Laboratory, that has been done; there is the fact that radium does not stay where you put it. It will dissolve from ore, from precipitants, from whatever form it is in; and if you put it in clear water or pure water, it picks up some of the radium. Now that will probably be some problem.

We anticipated that after building up so much of the precipitation material and brine in the second pond, we would convert that pond for a few days or a week to the primary pond, to cover that material up with coarse sand tailings. We feel that would be better than left accumulating in that one pond. As I understand it, as far as I know, no one else is doing this. Of course, some of them don't have the problem that we do.

MR. BELTER: You are talking about organic raffinate being treated in dual settling tanks, with chemical treatment. Are there any laboratory results to indicate what sort of efficiency you are going to get as far as treating organic raffinate with chemical treatment and settling?

MR. BRINKER: They ran the raffinate separately, and the acid ponds separately. Mr. Beverly could answer that.

MR. BEVERLY: We treated both the raffinate (that have the organic materials), and the acid pond tailings (that do not have organic materials) separately; and then we did tests on them mixed together at the ratio approximately at which they are produced at the mill. There was very little difference. I think we removed 70% from the raffinate, 80% from the solids, and it came out about 80% from the mixed tailings; so that the organic material did not seem to interfere with the treatment.

MR. BELTER: You think it absolutely approximates the efficiency of the removal for the organic material of 70 to 80%?

MR. BEVERLY: No, this is the removal of radium --

MR. BELTER: My question is, how effective is this treatment as far as removal of this toxic organic raffinate?

MR. BEVERLY: This is more a physical problem. Our barite sulphate treatment is strictly for the radium.

MR. BRINKER: The organic we are talking about is several organic chemicals dissolved in kerosene, which are lighter than water and appear on the surface. In the ponds they will appear on the surface and will be trapped in the sand in the pond. We anticipate, if there is any substantial amounts on either pond, that we will make our decant so that the liquid part is taken from underneath the surface so that it leaves the floating organic material in the ponds. Does that answer your question?

MR. STEIN: Are there any other comments, or questions?

MR. BELTER: I have one other question that I would like to ask Doctor Tsivoglou. In the report you indicate that there are several things to be reported on yet; for instance, a radium balance on the mill, fish analyses and winter samples. Is there another more-or-less final report to come out supplementing the general report?

DOCTOR TSIVOGLOU: Yes, there will be an Appendix to carry this on. We have all been concerned with knowing things over a longer period, and there will be this following Appendix, as these analyses are finished and as we have enough information to do this.

MR. STEIN: That's right. As you know, from the AEC, the problem we have is a budget operation. This goes into the next fiscal year. We hope to follow this through with follow-up surveys if they are appropriate. This will have to wait until our appropriation bill comes out.

Are there any other questions or comments? If not, I want to thank you people for coming and participating, and I think we have moved forward in this problem in a very reasonable manner.

With that, the conference is hereby declared adjourned.

Thank you.

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12:45 P.M.

APPENDIX A

Colorado Department of Public Health Statement

The Colorado Department of Public Health, over the Executive Director's signature, has notified Mayor Giacomelli of Silverton, that the Department requires to be advised of the city's intention as to what Silverton proposes to do in the way of providing sewage treatment facilities. In reply to this request, the Town Clerk of Silverton advised the Colorado State Department of Public Health that the Town of Silverton had a property evaluation of $560,000, and that the State Constitution placed a total limit for debt at 3% of this evaluation. Thus, the amount of money that Silverton can borrow on general obligation bonds is somewhat less than $17,000. The city already has $3,000 obligation bonds.

The Colorado State Department of Public Health is now proceeding with an investigation covering two general aspects. First; it is proposed to consult with the State Tax Commission and other fiscal agents as to what might be done in the way of financing a project leading to the construction of sewage treatment facilities. Secondly; the Department intends to secure as close an approximation of construction costs of a sewage treatment facility at Silverton as is possible. It must be kept in mind that construction costs in the Silverton area are generally higher than elsewhere. It is the intention of the Department to continue working with city officials in Silverton until a facility for the treatment of sewage is constructed which will produce an effluent in compliance with a newly-enacted amendment to the Colorado Public Health Laws. This amendment specifically states that sewage effluents discharged must not exceed 50 ppm B.O.D., in addition to similar limits of suspended and dissolved solids, settleable solids, and coliform organisms.

APPENDIX A

ATTENDANCE ROSTER
Second Session
Conference on Interstate Pollution
of the Animas River, Colorado-New Mexico
June 24, 1959

J. B. Anderson	U. S. Public Health Service, Dallas, Texas
Robert W. Balliger	San Juan Basin Health Unit, Durango, Colorado
G.V. Beard	DRM, Atomic Energy Commission, Washington, D.C.
Walter G. Belter	Division of Reactor Development, Atomic Energy Commission, Washington, D.C.
R.C. Beverly	National Lead Company, Grand Junction, Colo.
Lester E. Blaschke	Indian Health Division, U. S. Public Health Service, Albuquerque, N.M.
John R. Boyne, M. D.	San Juan County Health Dept., Farmington, N.M.
Fred A. Brehm	Vanadium Corporation of America, Durango, Colo.
Charles G. Caldwell	N.M. Dept. Public Health, Santa Fe, N.M.
William F. Crabtree	Bureau of Reclamation, Durango, Colorado
C.W. Christenson	Los Alamos Scientific Laboratory, Los Alamos New Mexico
Robert P. Davison	Holland & Hart, Denver, Colorado
John G. Detmer	Regional Attorney, Public Health Service, Denver, Colorado
David H. Flora	San Juan Basin Health Unit, Durango, Colo.
William N. Gahr	Colo. Dept. Public Health, Denver, Colo.
D. R. George	Atomic Energy Commission, Grand Junction, Colo.
L.S. Gerber, M. D.	U.S. Public Health Service, Denver, Colo.
Larry J. Gordon	Albuquerque Health Dept., Albuquerque, N.M.
Callie May	N.M. Dept. Public Health, Santa Fe, N.M.
Carl Henderson	N.M. Dept. Public Health, Santa Fe, N.M.
Carl R. Jensen	N.M. Dept. Public Health, Santa Fe, N.M.
Jack G. Koogler	State Engineer's Office, Santa Fe, N.M.

[illegible] T. League	[illegible] Public Health Service, Denver, Colorado
[illegible] J. Leland, M. D.	[illegible] Dept. Public Health, Santa Fe, N.M.
Robert P. Lowe	[illegible] Dept. Public Health, Santa Fe, N.M.
R.D. Lynn	[illegible] Company, Grants, New Mexico
George W. Marx	Arizona Dept. Public Health, Phoenix, Ariz.
[illegible] W. [illegible]	[illegible] Dept. Public Health, Santa Fe, N. M.
John [illegible] Mitchell	Vanadium Corporation of America, Durango, Colo
[illegible] McArthur	National Lead Company, Winchester, Mass.
[illegible] H. McIntosh	San Juan County Health Dept., Farmington, N.M.
[illegible] P [illegible]	[illegible] Health Division, Public Health Service, Winslow Road, Arizona
[illegible]	U.S. Public Health Service, Denver, Colo.
[illegible] J. Navarro	Dept. of Game and Fish, Santa Fe, N.M.
C. C. [illegible]	Div. of Inspection, Atomic Energy Commission, Washington, D. C.
Harold M. Hatcliff	National Park Service, Santa Fe, N.M.
Robert Reavis	City Engineer, Durango, Colorado
Lester R. Rogers	Div. of Licensing and Regulation, Atomic Energy Commission, Washington, D. C.
D. D. Rushing	U.S. Public Health Service, Salt Lake City, Utah
R. C. Scott	U.S. Geological Survey, Denver, Colorado
C. E. Sponagle	U.S. Public Health Service, Denver, Colo.
Leo G. Stearns	U.S. Geological Survey, Santa Fe, N.M.
Murray Stein	U.S. Public Health Service, Washington, D.C.
Calvin K. Sudbrocks	Utah Dept. Public Health, Salt Lake City, Utah
[illegible] M. Swope	U.S. Public Health Service, Dallas, Texas
Ernest C. Tsivoglou, Dr.	Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio
W. W. Towne	Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

Donald I. Walker	Atomic Energy Commission, Idaho Falls, Idaho
E. C. Wankentin	U.S. Public Health Service, Dallas, Texas
Arthur L. Warner, M. D.	San Juan Basin Health Unit, Durango, Colo.
R. M. Wilde.	Anaconda Company, Grants, New Mexico
Aubrey L. Willard	N.M. Dept. Public Health, Santa Fe, N.M.
C.T. Wright	Bureau of Reclamation, Salt Lake City, Utah
V. C. Verpe	Atomic Energy Commission, Albuquerque, N.M.

APPENDIX B

Colorado Department of Public Health Statement

Testimony presented by the City of Durango representative, Mr. Reavis, indicates that the new primary and secondary sewage treatment plant at Durango, for all practical purposes, can now be said to be in operation. This particular plant cost $734,987.54. It has been designed to serve a population of 20,000 persons. It is fully expected that this plant will produce an effluent in conformity with the newly-enacted statutory effluent quality standards.